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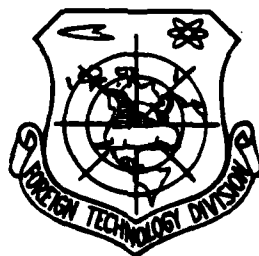
FOREIGN TECHNOLOGY DIVISION



CHINA'S BALLISTIC MISSILE PROGRAM

by

Mark Weder



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CHINA'S BALLISTIC MISSILE PROGRAM

Originally written by Mark Weder. Edited translation by Wang Chen.

An article discussing progress in China's development of ballistic missiles and satellite carrier rockets was published in the eighth issue of 1980 of the Swedish publication 'International Defense Review.' The following edited translation is provided for the reference of our readers. By publishing this article, we are neither indicating that this publication agrees with the viewpoint of the writer, nor are we confirming the accuracy of his report. We are merely providing our readers with a critical account of how the outside world sees progress in the field of aerospace in our country.

As early as 1944 the intelligence agencies of the Chinese Communist Party had already learned that the United States was developing the atomic bomb. After this new weapon had been used for the first time, and when reports concerning the German V-2 were made public after the war, Chinese Communist Party officials saw clearly that these new technologies would be a serious threat to the security of their country. For this reason, once they had seized political power, the new China had to be able to master these new technologies in order to safeguard national security and independence.

For this reason, the departments concerned in China undertook the task of persuading Chinese receiving Western technological training abroad to return to China. This included those in the domain of guided missiles and nuclear weapons. They first of all drew up a list of over two hundred names, all of whom were overseas Chinese working in the fields of mathematics, physics and engineering. Beginning in the year 1946 and more intensively from 1947, they

carried out the delicate and painstaking work of ensuring that these overseas Chinese should return to China.

China Begins to Develop Guided Missiles

In the course of the laying of the foundations by China of a defense industry, the Soviet Union provided so-called 'unselfish and generous' assistance. But the Soviets kept the latest control systems under wraps, and this gave rise to some contradictions. What the Chinese obtained was almost obsolete and so they desperately wanted more advanced equipment. Once, when there were no Soviet supervisors around, a Chinese trainee in a Soviet training school studied a V750V K Guideline ground-to-air missile undisturbed for several hours. This infuriated the Soviets so much that they ended up having the student arrested. In 1958 a Chinese Mig fighter got into aerial combat with a Taiwanese F-86 Saber jet fighter in the airspace above Quemoy and Matsu. By chance, an American AIM-9 Sidewinder air-to-air guided missile hit the target but failed to explode. This guided missile was subsequently sent to the Soviet Union after the Chinese had removed certain key components. At that time the Soviet Union was developing a copy of that type of guided missile, the K-13A, and these components were urgently required. This consequently had a considerable effect on the development.

As far as ballistic missiles were concerned, the Soviet Union was even more secretive. The most advanced guided missile that the Chinese were allowed to come in contact with was SS-2 Sibling. This was basically nothing more than a speeded-up, scaled-up version of the V-2 guided missile. Its engine was the RD 101 with thrust of 43 tons, using for fuel liquid oxygen and 92.5% ethanol, with specific thrust of 238 seconds. In reality, this type of guided missile had none of the advanced features of things that the Chinese students were familiar with in America. However, in the end some rocket cases, a few assembly tools and training methods were all that was supplied. These were the starting point for China's independent development of guided missiles.

Once the Soviets began increasingly to suspect that the Chinese were developing guided missiles and nuclear weapons independently, the supply of materials and technology to China was suspended. Khrushchev personally made the decision to refuse to supply to China a sample of an atomic bomb which had already been promised. This shattered the foundation stone upon which was established the Sino-Soviet Alliance, and not long after that, in June 1959, assistance in sophisticated technology was completely interrupted.

At that time, the Chinese were proposing to develop an engine that would develop 70 tons of thrust to be the foundation of China's development of a

ballistic missile program. This type of engine had necessarily to be either linked in parallel or in multistage series connection, burning storable propellant. Using this kind of engine could provide an entire series of ballistic missile and space launchers. This was analogous to American practice. In America, the 27 ton B-2 engine was developed, by way of the Redstone missile, into the 68 ton engine used in the Thor, Jupiter, Atlas and Titan 1 ballistic missiles.

China's first guided missile program was as follows: (See Table 1)

(1) A single engine guided missile (70 ton launch thrust)

This was a medium range ballistic missile (MRBM) with a launch weight of 25 tons. It resembled the Soviet SS-3 Shyster guided missile. It is probable that the Chinese already had the preliminary concept for such a missile prior to the split with Moscow. Like the SS-3's successor, the SS-4 Sandal guided missile, the Chinese selected N_2H_4 and UDMH as the storable propellant for the engine. Consequently, it had a range of up to 1,100 kilometers and could carry a one ton fission warhead. The American Defense Department called this guided missile CSS-1.

(2) A twin engine guided missile (140 ton launch thrust)

This was an intermediate range ballistic missile (IRBM) similar to the American Thor, Jupiter, and Soviet SS-5 Skean missiles. With a launch weight of 50 tons and a range of 2,500 kilometers, it could carry a two ton thermo-nuclear warhead. (The Americans called it CSS-2).

(3) A 4+1 engine two-stage guided missile (280 ton launch thrust)

This was an intercontinental ballistic missile (ICBM) resembling the Soviet SS-9 Scarp or the American Titan 2 missiles. With a launch weight of 200 tons and a range of more than 10,000 kilometers, it could carry a two ton thermonuclear warhead. (The Americans called it CSS-4).

From Developing Guided Missiles to Launching Satellites

Despite China's limited resources, this program went ahead at great speed, and an offensive nuclear weapons program was proposed. During the six years that followed the split with the Soviet Union, the Chinese resolved the following problems one after another: how to manufacture and safeguard a new type of toxic, storable propellant; how to enhance the performance of the RD-101 engine using this new type of propellant; how to assemble each of the

Table 1. China's ballistic missiles (Translator's note: This part of the caption is illegible.)

US serial number	CSB-1	CSB-2	CSB-3	CSB-4	CSB-N-2 (submarine launched)
Diameter (Meters)	1.6	2.4	2.4 ?	2.3	1.6 ?
Length (meters)	22	23	25 ?	30	10 ?
Thrust (1st+2nd stages)	70 tons	140 tons	140 tons + ?	200 + 70 tons	?
Launch weight (tons)	25	50	70 ?	200	20 ?
Carrying capacity (kgs)	1,000	2,000	2,000 ?	2,000	1,000 ?
Warhead yield	20 kiloton	3 megaton	3 megaton	3-4 megaton	1 megaton ?
(illegible) range (kms)	650	2,300 ?	2,300 ?	8,000	not tested
(illegible) range (kms)	1,100	2,600	4,500	11,000	2,000 ?
First known test	10.27.1966	1969 ?	late 1970	5.17.1980	not tested
First deployed	1970	1972	1973	1983 ?	1984 ?
CSB-1 1960	50-60	15-20	0-3	0	0
CSB-2 Estimated 1965	70	15	0	8	3 ?
CSB-3 Estimated 1980	50	15	0	15	18 ?
Thrust direction control	fixed	movable jets	movable jets	1st stage movable jets 2nd stage jet valves	?
Control	autopilot	radar ?	radar ?	inertial	inertial
Propellant	H ₂ O / UDMH	H ₂ O / UDMH	H ₂ O / UDMH	H ₂ O / UDMH	solid fuel
Launch equipment	transporter	silo	silo	silo	submarine
Reaction time	several hours	several minutes	several minutes	several minutes	several minutes

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many components into an entirely enhanced missile. On October 27, 1966, China launched a prototype CSS-1 missile carrying a 20 to 30 kiloton yield fission warhead, hitting a target in the Gobi Desert at a range of 650 kilometers. The Cultural Revolution seemed to be having little impact on this top priority guided missile program. By the end of 1969, the guided missiles and engines were fully developed and preparations were made to put them into production.

To announce this newly acquired capability, China launched her first man-made satellite on November 1, 1969. The launcher for the man-made satellite was the CSS-1 or the CSS-2 with a low-performance second stage component added. This was similar to the earlier American Jupiter-C and Juno launchers. But this first launch was a failure as the satellite did not go into orbit. The next test was successfully concluded on April 24, 1970.

From the standpoint of putting a satellite into orbit, all resources at that time were being put into the production and development of guided missiles. The CSS-1 corresponded to the Soviet SS-2 type of missile and may probably have still been using some of the same dies. The diameter of the lower section was 1.6 meters, the nose was pointed, a carbon vane was used to control the direction of thrust, and the control module was installed in the space between the propellant tanks. To deploy the CSS-1, a large launcher and numerous auxiliary and fuelling trucks were required. Launch preparations also took a very long time.

CSS-2 was a 'Great Leap Forward' in the direction of modern guided missiles. With a diameter increased by 50% to 2.4 meters, it was almost as big as the diameter of the Thor and SS-5 missiles. The axial section diameter of the rocket was unchanged, using movable jets or jet vanes to control the direction of thrust and it could carry a 3 megaton yield warhead. As it was deployed in reinforced, underground missile silos and could be fuelled beforehand, its reaction time was much shorter than that of the CSS-1.

The maiden test flight of the CSS-2 was in 1969. At that time the CSS-1 had only just gone into production. After a very limited number of test flights, the CSS-2 also went into production in 1972. Throughout the 1970s, the CSS-1 and CSS-2 were in production simultaneously.

It was probably at about this time that proposals were made to plan CSS-3. However, because of a lack of manpower, financial and material resources, the annual production of large-scale rocket engines could amount to no more than 12 to 15 units, and one CSS-4 missile required five such engines. For this reason there were obviously not enough engines; additionally there was probably

the question of guidance to be worked out, without which there could not be a reliable intercontinental ballistic missile; finally, as a result of some effective diplomatic activity, the threat from the direction of the United States had been removed, and the United States had formerly been the primary target for that type of missile. For all these various reasons, the CSS-3 was suspended.

What in fact was the CSS-3 has never been known for sure. It could not have been larger than the CSS-2 with an additional stage added. Whatever it was, it gave China at the end of 1970 the test capability to launch a guided missile 6,500 kilometers carrying a 3 megaton yield warhead. By the end of 1975, at least three silos for this type of missile had been completely deployed. While this gave the American intelligence agencies quite a scare, missiles were never in fact installed in these silos.

Although at first the questions of guidance and production constraints hindered the deployment of the 200 ton CSS-4 as an intercontinental ballistic missile, it could nevertheless be used to launch satellites. From 1975 to 1978 the CSS-4 in all launched a series of five heavy-weight (2000 kg.) military reconnaissance satellites. Of these, the first one launched in 1975 and the third were not recovered. The other three launched in 1976, 1977 and the winter of 1978 respectively were all recovered. Recovery was carried out at two locations on land. Clearly, they were employed as photographic reconnaissance satellites to find out about the military deployments of other countries, and they were also capable of carrying living things. (See Table 2)

With the exception of the Soviet SS-18, the CSS-4 was the world's largest missile. But the efficiency of its engines was relatively low, and its carrying capacity was only half that of Titan 2 (its relative thrust of 280 to 290 seconds may be compared with the 310 seconds of the Soviet and American storable liquid fuelled rockets). For this reason the overall performance of this missile was about the same as that of the Atlas.

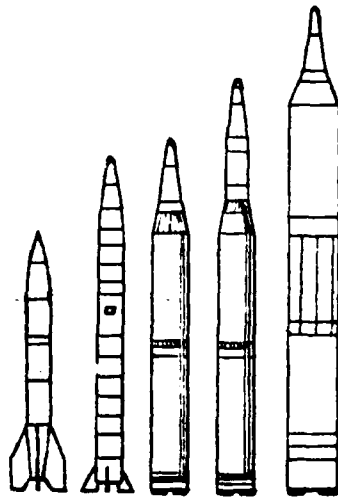
China's Plans for the Immediate Future

As a result of production constraints, China has no alternative to alternate development of missiles and space flights, being unable to develop the two simultaneously. As there were no satellite launches from 1971 to 1975, production of the CSS-1 and the CSS-2 reached a peak during that period. As the emphasis from 1975 to 1978 was on launching military reconnaissance satellites, the CSS-3 was discontinued and the production rate of the CSS-1 and the CSS-2 was reduced.

Table 2. China's space program. (This table represents the author's estimates of China's satellites, and appeared originally in 'International Defense Review').

Satellite program	Satellite weight	Launcher	Launch number	Date	Perigee (km)	Apogee (km)	Orbit parameters (mins)	Inclination
Test launch	173 kg.	CSL-1	China 0	11. 1.69	(Did not enter orbit)			88.5°
			China 1	9.24.70	439	2,384	114	
			China 2	3. 2.71	268	1,828	108	
Technological experiment	221 kg.	CSL-1	China 6	8.30.75	195	2,180	108.8	89.8°
			China 9B	July 79	(Did not enter orbit)			89.2°
			China 9	Scheduled 1980	230 ?	2,000 ?	107 ?	89.8° ?
			China 10	Scheduled 1980	230 ?	2,000 ?	107 ?	89.3° ?
			China 9A	Winter 78/79	(Did not enter orbit)			89.0° ?
Heavy military satellite	2,000 kg.	CSL-2	China 3	7.28.75	184	461	91	89.0° ?
			China 5	12.16.75	188	388	90	89.0° ?
Satellite recovery	2,000 kg.	CSL-2	China 4	11.26.75	170	479	91	82.6°
			China 7	12. 7.76	163	489	89	80.0°
			China 8	1.26.78	161	479	91	80.0°
			China 9A	Winter 78/79	(Did not enter orbit)			87.0°
Communication satellite	420 kg.	CSL-3	STW-1	Scheduled 1981	Synchronous above longitude 125° E.			125° E.
			STW-2	Scheduled 1982	Synchronous above longitude 70° E.			70° E.
Atmospheric satellite	650 kg.	CSL-2		Scheduled 1982	900	900	103	100.0°
Manned flight	2,000 kg.	CSL-2		83/84 ?	165 ?	350 ?	90 ?	80.0° ?
Weather satellite	420 kg.	CSL-3		Scheduled 1985	Synchronous			
Space flight		CSL-3		After 1985	Planetary orbit			

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External appearance
From left to right: the
Soviet SS-2, the Chinese
CSS-1, CSS-2, CSS-3 and
CSS-4

The suspension of space flights in 1978 indicated that military development had been stepped up. In May 1980 the reason for that suspension became apparent when China carried out two CSS-4 tests in succession. It is evident that it now requires two or three years to deploy this type of guided missile at the slower rate.

Although China has already announced an ambitious program of civilian space flight in the 1980s, the number of launches is not great. Research is now going on to add a liquid oxygen / hydrogen fuelled third stage rocket to the CSS-4, to be used to place communication satellites and atmospheric satellites in synchronous orbits. There are also plans to launch a low-altitude weather satellite and a manned space craft during the first half of the 1980s.

It is frequently reported that China is developing a large-scale solid fuelled rocket to be deployed as a submarine launched ballistic missile (BLBM).

To realise such an objective, however, requires enormous investment; the large-scale deployment of such a missile is made very difficult by the problems of deploying submarines safely in any part of the oceans, of enabling a missile to hit important targets particularly in the European part of the Soviet Union, and of communication. A more practical idea is to deploy mobile, land-based intermediate range missiles with a range of about 4,000 kilometers in Xinjiang, to be a threat to the Soviet heartland.

The nuclear strengths of China and France have many similarities. On almost the same scales, both countries are striving to establish a deterrent force, with the object of breaking the numerical monopoly of the superpowers in sophisticated technology and strategic weapons. But China's strength at the moment is weaker, with scarcely a first-strike capacity, not to mention a real deterrent force. Therefore, China hopes, during the last half of the 1980s, to deploy all kinds of land-based, sea-based and maneuverable space ballistic missiles, to strengthen that deterrent force.

The End

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